IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re: Application of: Dresch et. al
Serial No.: 09/808,468 December 9, 2003
Art Unit: 2881
Examiner: K.T. Nyguen
Filing Date: March 14, 2001
For: Ion Storage Time-Of-Flight Mass Spectrometer
Attorney Docket No. 840.066.202

Dear Madam

The following is a response to the Office Action of June 26, 2003, regarding Non-Provisional U.S. Application No. 09/808,468 Continuation, titled "Ion Storage Time-of-Flight Mass Spectrometer" (attorney file No. 840.066.202).

The Examiner has rejected all Claims 11-13.

Double Patenting Claims Rejection – 35 U.S.C. 101

The Examiner has rejected Claims 11-13 as claiming the same invention as U.S. Patent 6,020,586 to Dresch et al.

Response:

Claim 11 is currently written:

11. (Amended) An apparatus for analyzing chemical species comprising:
a time-of-flight mass analyzer with an ion pulsing region and a detector;
an ion source for producing ions from said chemical species;
a two-dimensional multipole ion guide having an entrance end where ions enter said ion guide from said ion source and an exit end where ions exit said ion guide;
said two-dimensional multipole ion guide functioning as a two-dimensional ion trap;
wherein said two-dimensional multipole ion guide comprises a plurality of spaced apart rods parallel to each other and extending from said entrance end to said exit end;
means for pulsing said ions transferred from said pulsing region into said time-of-flight mass analyzer for mass analysis;
and means for detecting said mass analyzed ions.

It is proposed to change Claim 11 to:

11. (Amended) An apparatus for analyzing chemical species comprising:
a time-of-flight mass analyzer with an ion pulsing region and a detector;

an ion source for producing ions from said chemical species;

a two-dimensional multipole ion guide having an entrance end where ions enter said ion guide from said ion source and an exit end where ions exit said ion guide;

<u>an ion exit lens proximal to said exit end;</u>

<u>means for applying an ion exit lens voltage to said ion exit lens, whereby said ion exit lens voltage may be either a trapping voltage for trapping said ions in said two-dimensional multipole ion guide, or a transfer voltage for transferring said ions from said two-dimensional multipole ion guide into said pulsing region;</u>

means for pulsing said ions transferred <u>into</u> said pulsing region into said time-of-flight mass analyzer for mass analysis;

and means for detecting said mass analyzed ions.

Also, reiterate amended claims 12 and 13:

12. (Amended) An apparatus as set forth in Claim 11 comprising means to control the timing of said means for pulsing said ions transferred into said pulsing region.

13. (New) An apparatus as set forth in claim 11, wherein said ions in said multipole ion guide are scanned at a scan rate sufficiently rapid to prevent excessive charge buildup in said multipole ion guide.

<u>Claims Rejection – 35 U.S.C. 102(b)</u>

The Examiner has rejected Claims 11-13 as being anticipated by Davis et. al. U.S. Patent 5,180,914.

The Examiner states in the Office Action of Apr. 1, 2002, and reiterates without qualification in subsequent Office Actions of Oct. 1, 2002 and June 26, 2003:

"Davis et al. disclose, in figs. 1-8(b), a mass spectrometry system. The system includes an ion source 10 for producing ions; **an ion storage quadrupole 20 which is a two dimensional multipole ion guide** (see col. 5, lines 7-8; and col. 9, line 60 to col. 10, line 6); **an ion pulsing region 30 having a laser pulse for pulsing the ions**; a time of flight mass analyzer 40; and a detector (see fig. 5). The ions in the quadrupole 20 are scanned at a scan rate for preventing excessive charge buildup in the quadrupole (see col. 7, lines 40-45). Means for controlling the time relationship between the time of the laser pulse and the time of the quadrupole is used to control the duty cycle of the analyzer (see col. 11, line 50-68)."

<u>Response:</u>

A. The examiner states that the mass spectrometry system of Davis et al. includes "**an ion storage quadrupole 20 which is a two dimensional multipole ion guide** (see col. 5, lines 7-8; and col. 9, line 60 to col. 10, line 6)".

The examiner misunderstands the device 20 of Davis.

The function of the device 20 of Davis is to establish an electrostatic field which acts on the ions within a segment of an ion beam such that ions of a particular mass-to-charge all eventually arrive at a point on the beam axis at essentially the same time (hence, an "ion buncher").

(See Col. 2, lines 58-64: *"...the first time-of-flight device 20 comprises an ion storage device (alternatively termed an ion buncher). This device separates the received ions in accordance with their different mass-to-charge ratios and has the effect of bringing ions having the same mass-to-charge ratio to a time focus."*)

Indeed, device 20 in the Davis '914 patent is first referred to as "*...the first time-of-flight device 20 comprises an ion storage device (alternatively termed an <u>ion buncher</u>).*" (Col. 2, lines 56, 59, 60.)

Device 20 accomplishes this time focus by establishing an electrostatic retarding field for a certain period of time that acts to decelerate the ions along their beam axis as they enter and travel into this first time-of-flight device 20. When the field is turned off, ions in the front will have experienced the retarding field longer, and hence will have been slowed down more, than ions in the rear. Hence, at some point in time, the rear-most ions will 'catch up' with forward-most ions, resulting in a bunching, or time-focussing, effect.

As Davis teaches, the preferred potential distribution for accomplishing such time focusing is a field in which the potential varies with the square of position along the beam axis. (See eq. (2)). A potential distribution that varies with the square of a position coordinate (or, equivalently, where the field varies linearly with position coordinate) is well-known as the definition of a quadrupole field. (Dawson, pgs. 9 and 10.) (See e.g., eq.(4)).

As the Examiner notes, col. 5, lines 7-8 reads: "*A preferred electrostatic retarding field for the ion storage device 20 is an electrostatic quadrupole field*". This statement simply identifies that the preferred potential distribution for time focusing is one that varies with the square of position along the beam axis. It does not imply a multipole ion guide structure of any sort.

Further, the Examiner cites col. 9, line 60 to col. 10, line 6:
"*Adopting the Cartesian co-ordinate system of Fig. 1, the distribution (in two dimensions) of electrostatic potential V(x,y) in the electrostatic quadrupole field satisfies the condition* $V(x,y) = V_0(x^2-r^2)/r_0^2$ *where* V_0 *is a constant and x,y are the X,Y position co-ordinates in the field region.*
An electrostatic field of this form has four-foldsymmetry about the Z-axis and could be generated by a quadrupole electrode structure (which provides field in all four quadrants) or a monopole electrode structure (which provides field in only one of the quadrants)".

This passage refers to the second time-of-flight device 40, and not the first time-of-flight device 20. However, in any case, a ststic electrostatic field is referred to that is similar to that of the first time-of-flight device 20, in that a potential distribution that varies with the square of position along the ion beam axis is employed in the time-of-flight analysis of ions entering this region.

Consequently, device 20 is not "an ion storage quadrupole ... which is a two dimensional multipole ion guide", as contended by the Examiner, specifically, because:

1) There is no actual 'storage', i.e., ions are not 'stored' in the sense that ions may be stored indefinately by RF and DC fields in a two-dimensional or three-dimensional ion trap. Rather, ions are simply slowed down, and 'bunched' (in device 20), or reflected (in device 40).

2) There is not a quadrupole (structure), i.e., there is no structure constructed of 4 'poles' or rods with RF voltages applied, as in a quadrupole ion guide of the present invention.

3) There is no 'multipole ion guide' like in the present application, because:
   (a) Device 20 of '914 employs a constant electrostatic field that provides deceleration of ions along the ion beam axis. Multipole ion guide, as in the present application, have no field components along beam axis to accelerate or decelerate ions; and
   (b) Multipole ion guides employ periodically varying RF voltages applied to the multipole electrodes which constrain the motion of ions in directions orthogonal to the beam axis. The device 20 of '914 does not employ periodically varying RF voltages.

B. The examiner states that the mass spectrometry system of Davis et al. includes **"an ion pulsing region 30 having a laser pulse for pulsing the ions".**

The Examiner has misunderstood the "ion pulsing region" of Claim 1. The ion pulsing region of Claim 1 is explicitly described in the patent application as the region of the time-of-flight analyzer where a pulsed electrostatic field pulse-accelerates ions into the time-of-flight analyzer. Without this pulsed acceleration field, ions are not directed into the time-of-flight analyzer for mass-to-charge analysis.

On the other hand, the region 30 of the Davis '914 patent is the region where the ions which traveled through the first time-of-flight device 20 are brought to a time focus. It is at this point in space where a laser beam pulse may be directed to intercept the time-focussed ions within region 30. In region 30 of the '914 Davis patent, ions are not subjected to a pulsed electrostatic accedleration field as in the present patent application.

Therefore, it is argued that the '914 Davis patent does not anticipate the present patent application, as contended by the Examiner.

Respectfully Submitted,

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